TURBOJET.

Jet engine in which a turbine-driven compressor draws in and compresses air, forcing it into a combustion chamber into which fuel is injected. Ignition causes the gases to expand and to rush first through the turbine and then through a nozzle at the rear. Forward thrust is generated as a reaction to the rearward momentum of the exhaust gases.

During the 1960´s the turbofan, or fanjet, a modification of the turbojet, came into common use. Some of the incoming air is bypassed around the combustion chamber and is accelerated to the rear by a turbine-operated fan. The turbofan moves a much greater mass of air than the simple turbojet, providing advantages in power and economy.

Compare ramjet. Any of a class of internal-combustion engines that propel aircraft by means of the rearward discharge of a jet of fluid, usually hot exhaust gases generated by burning fuel with air drawn in from the atmosphere.

General characteristics.

The prime mover of virtually all jet engines is a gas turbine. Variously called the core, gas producer, gasifier, or gas generator, the gas turbine converts the energy derived from the combustion of a liquid. hydrocarbon fuel to mechanical energy in the form of a high-pressure, high-temperature airstream. This energy is then harnessed by what is termed the propulsor (e.g., airplane propeller and helicopter rotor) to generate a thrust with which to propel the aircraft.

Principles of operation.

The prime mover. The gas turbine operates on the Brayton cycle in which the working fluid is a continuous flow of air ingested into the engines inlet. The air is first compressed by a turbocompressor to a pressure ratio of typically 10 to 40 times the pressure of the inlet airstream. It then flows into a combustion chamber, where a steady stream of the hydrocarbon fuel, in the form of liquid spray droplets and vapour or both, is introduced and burned at approximately constant pressure. This gives rise to a continuous stream of high-pressure combustion products whose average temperature is typically from 980º to 1540º C or higher. This stream of gases flows through a turbine, which is linked by a torque shaft to the compressor and which extracts energy from the gas stream to drive the compressor. Because heat has been added to the working fluid at high pressure, the gas stream that exits from the gas generator after having been expanded through the turbine contains a considerable amount of surplus energy, --i.e., gas horsepower-- by virtue of its high pressure, high temperature, and high velocity, which may be harnessed for propulsion purposes.

The heat released by burning a typical jet fuel in air is approximately 43370 kilojoules per kilogram (18650 British thermal units per pound) of fuel. If this process were 100 percent efficient, it would then produce a gas power for every unit of fuel flow of 7,45 horsepower/(pounds per hour), or 12 kilowatts/(kilograms per hour). In actual fact, certain practical thermodynamic limitations, which are a function of the peak gas temperature achieved in the cycle, restrict the efficiency of the process to about 40 percent of this ideal value. The peak pressure achieved in the cycle also affects the efficiency of energy generation. This implies that the lower limit of specific fuel consumption (SFC) for an engine producing gas horsepower is 0.336 (pound per hour)/horsepower, or 0.207 (kilogram per hour)/kilowatt. In actual practice, the SFC is even higher than this lower limit because of inefficiencies, losses, and leakages in the individual components of the prime mover.

Because weight and volume are at a premium in the overall design of an aircraft and because the power plant represents a large fraction of any aircraft´s total weight and volume, these parameters must be minimized in the engine design. The airflow that passes through an engine is a representative measure of the engine's cross-sectional area and hence its weight and volume. Therefore, an important figure of merit for the prime mover is its specific power-the amount of power that it generates per unit of airflow. This quantity is a very strong function of the peak gas temperature in the core at the discharge of the combustion chamber.
Modem engines generate from 150 to 250 horsepower/(pound per second), or 247 to 411 kilowatts/(kilogram per second).

The propulsor.

The gas horsepower generated by the prime mover in the form of hot, high-pressure gas is used to drive the propulsor, enabling it to generate thrust for propelling or lifting the aircraft.

There are two general approaches to converting gas horsepower to propulsive thrust. In one, a second turbine (i.e., a low-pressure, or power, turbine) may be introduced into the engine flow path to extract additional mechanical power from the available gas horsepower. This mechanical power may then be used to drive an external propulsor, such as an airplane propeller or helicopter rotor. In this case, the thrust is developed in the propulsor as it energizes and accelerates the airflow through the propulsor, i.e., an airstream separate from that flowing through the prime mover.

In the second approach, the high-energy stream delivered by the prime mover may be fed directly to a jet nozzle, which accelerates the gas stream to a very high velocity as it leaves the engine, as is typified by the turbojet. In this caw, the thrust is developed in the components of the prime mover as they energize the gas stream

In other types of engines, such as the turbofan, thrust is generated by both approaches: A major part of the thrust is derived from the fan, winch is powered by a low-pressure turbine and which energizes and accelerates the bypass stream. The remaining part of the total thrust is derived from the core stream, which is exhausted through a jet nozzle.

Just as the prime mover is an imperfect device for converting the heat of fuel combustion to gas horsepower, so the propulsor is an imperfect device for converting the gas horsepower to propulsive thrust. There is generally a great deal of energy left in the high-temperature, high-velocity jet stream exiting from the propulsor that is not fully exploited for propulsion. The efficiency of a propulsor, propulsive efficiency **p**, is the portion of the available energy that is usefully applied in propelling the aircraft compared to the total energy of the jet stream.

The net assessment of the efficiency of a jet engine is the measurement of its rate of fuel consumption per unit of thrust generated (e.g., in terms of pounds, or kilograms, per hour of fuel consumed per pounds, or kilograms, of thrust generated). There is no simple generalization of the value of specific fuel consumption of a thrust engine. It is not only a strong function of the prime mover's efficiency (and hence its pressure ratio and peak-cycle temperature) but also of the propulsive efficiency of the propulsor (and hence of the engine type). It also is a strong function of the aircraft flight speed and the ambient temperature (which is in turn a strong function of altitude, season, and latitude).

Basic engine types.

Achieving a high propulsive efficiency for a jet engine is dependent on designing it so that the exiting jet velocity is not greatly in excess of the flight speed. At the same time, the amount of thrust generated is proportional to that very same velocity excess that must be minimized. This set of restrictive requirements has led to the evolution of a large number of specialized variations of the basic turbojet engine, each tailored to achieve a balance of good fuel efficiency, low weight, and compact size for duty in some band of the flight speed-altitude-mission spectrum. There are two major general features characteristic of all the different engine types, however.

First, in order to achieve a high propulsive efficiency, the jet velocity, or the velocity of the gas stream exiting the propulsor, is matched to the flight speed of the aircraft (slow aircraft have engines with low jet velocities and fast aircraft have engines with high jet velocities).

Second, as a result of designing the jet velocity to match the flight speed, the size of the propulsor varies inversely with the flight speed of the aircraft (slow aircraft have very large propulsors, as for example, the helicopter rotor) and the relative size of the propulsor decreases with increasing design flight speed (turboprop propellers are relatively small and turbofan fans even smaller).

Although the turbojet is the sirnplest jet engine and was invented and flown first among all the engine types, it seems useful to examine the entire spectrum of engines in the order of the flight-speed band in which they serve, starting with the slowest, namely the turboshaft engine, which powers helicopters.

(Nota): Texto obtenido a partir de definiciones y artículos de la Enciclopedia Británica.